National Aeronautics and Space Administration

Langley Research Center's

Scramjet Test Complex

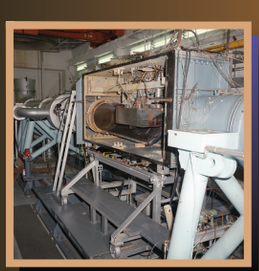
The facilities of NASA Langley's Scramjet Test Complex - the Combustion-Heated Scramjet Test Facility, the Direct-Connect Supersonic Combustor Test Facility, and the Arc-Heated Scramjet Test Facility - have been conducting hypersonic propulsion research since the 1960's.

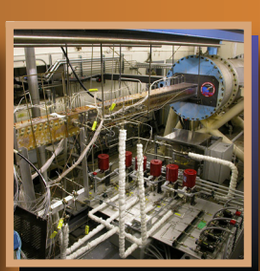
The Scramjet Test Complex facilities have the capability to test integrated engines, supersonic combustors, and inlets at simulated flight Mach numbers from 3.5 to 8, and Reynolds numbers from 0.035×10^6 to 6.8×10^6 per foot.

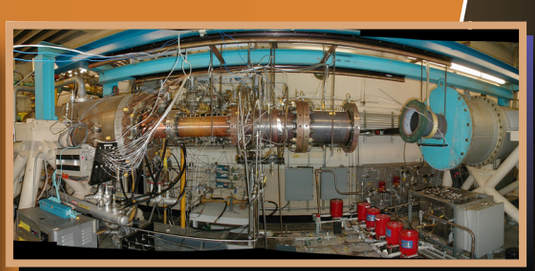
Data from these facilities have been used to improve engine reliability and robustness, to develop control laws for flight research projects and to calibrate and verify Computational Fluid Dynamics codes used to analyze scramjet engine performance.

Upgrades in recent years have improved the performance, reliability, and capabilities. Modifications include a PLC-based control system, a 20MW DC power supply, improved fuel and air supply systems at the Arc-Heated Scramjet Test Facility, and a fuel heater that supplies cracked JP fuel for the Direct-Connect Supersonic Combustion Test Facility.

The Scramjet Test Complex facilities have made significant contributions to major research programs such as the Hypersonic Research Engine, NASP, and Hyper-X.







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Facility Benefits

- Three complementary facilities dedicated to research in hypersonic air-breathing propulsion and related subject areas.
- Different test media and overlapping simulated test condition ranges.
- Fuels include: hydrogen, silane/hydrogen igniter or piloting, gaseous hydrocarbon mixes, and heated cracked JP fuel.
- PLC-based control systems can control test article components.
- Data acquisition systems and post processing capabilities provide rapid data reduction turn around.

Facility Applications

- The Scramjet Test Complex has made significant contributions to NASA's hypersonic air-breathing propulsion research programs, the NASP Program, Hyper-X (X-43), and HIFiRE.
- All NASP Program major competitors tested their engine designs in these facilities.
- Flow path and propulsion control laws for the Hyper-X (X-43) Mach 7 vehicle, developed with data from the Scramjet Test Complex facilities, enabled the X-43 vehicles to achieve world record performance goals.

Characteristics

Facility	Arc-Heated Scramjet Test Facility	Combustion-Heated Scramjet Test Facility	Direct-Connect Supersonic Combustor Test Facility
Test medium	Dry air	Hydrogen-air combustion products with oxygen replenishment	Hydrogen-air combustion products with oxygen replenishment
Simulated flight Mach number	4.7 to 8	3.5 to 6	4 to 7.5
Flight Reynolds number, ft^{-1}	$0.035x10^6$ to $2.2x10^6$	$1.0x10^6$ to $6.8x10^6$	$2.0x10^6$ to $8.0x10^6$
Total pressure limit, psia	675 psia	50 to 500	115 to 500
Total temperature, degrees R	2000 - 5200	1300 - 3000	1600 - 3800
Nozzle Mach number/size, in.	Mach 4.7 - 11.17 by 11.17 in. Mach 6.0 - 10.89 by 10.89 in.	Mach 3.5 - 13.26 by 13.26 in. Mach 4.7 - 13.26 by 13.26 in.	Mach 2.0 - 1.52 by 3.46 in. Mach 2.7 - 1.50 by 6.69 in.
Test time, sec.	120	20	120

Instrumentation

A large pool of instrumentation can be shared among facilities

Six-component strain gage balances
Electronically scanned pressure transducers in a wide array of ranges
Temperature sensors
Heat flux gages
Flow rate meters
Visual access for Schlieren and non-intrusive laser based test techniques

Data Acquisition and Processing

PC based COTS	
Front ends	192-230 Channel A/D multiplexor 512 channel pressure scanner
DAS rate	10-50 Hz
Customer computers	available
High speed DAS	available
Classified capability	Yes

Contact Information

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